

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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VOLKSWAGEN GROUP OF AMERICA, INC. and  
PORSCHE CARS NORTH AMERICA, INC.,  
Petitioner

v.

YECHEZKAL EVAN SPERO,  
Patent Owner.

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IPR2023-00335<sup>†</sup>  
U.S. Patent 10,894,503 B2

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Before JON M. JURGOVAN, JASON W. MELVIN, and  
AARON W. MOORE, *Administrative Patent Judges*.

MOORE, *Administrative Patent Judge*.

JUDGMENT  
Final Written Decision  
Determining All Challenged Claims Unpatentable  
35 U.S.C. § 318(a)  
Dismissing Petitioner's Motion to Exclude Evidence  
37 C.F.R. § 42.64(c)

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<sup>†</sup> Porsche Cars North America, Inc., which filed a petition in IPR2023-01321, has been joined as a party to this proceeding.

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## I. BACKGROUND

Volkswagen Group of America, Inc. (“Petitioner”) filed a Petition (Paper 2, “Pet.”) requesting *inter partes* review of claims 1–19 and 37–58 of U.S. Patent No. 10,894,503 B2 (Ex. 1001, “the ’503 patent”). Yechezkal Evan Spero (“Patent Owner”) filed a Preliminary Response (Paper 6, “Prelim. Resp.”).

We instituted *inter partes* review on July 17, 2023 (*see* Paper 11, “Inst. Dec.”), Patent Owner filed a Response (Paper 19, “PO Resp.”), Petitioner filed a Reply (Paper 24, “Pet. Reply”), and Patent Owner filed a Sur-Reply (Paper 28, “PO Sur-reply”).

An oral hearing was held on April 16, 2023, and a transcript of the hearing is included in the record, as are the demonstratives. *See* Paper 39 (“Tr.”); Ex. 1072 (Petitioner Demonstratives); Ex. 2029 (Patent Owner Demonstratives).

We issue this Final Written Decision under 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73 and, for the reasons that follow, determine that Petitioner has shown, by a preponderance of the evidence, that claims 1–19 and 37–58 are unpatentable.

### A. *Related Matters*

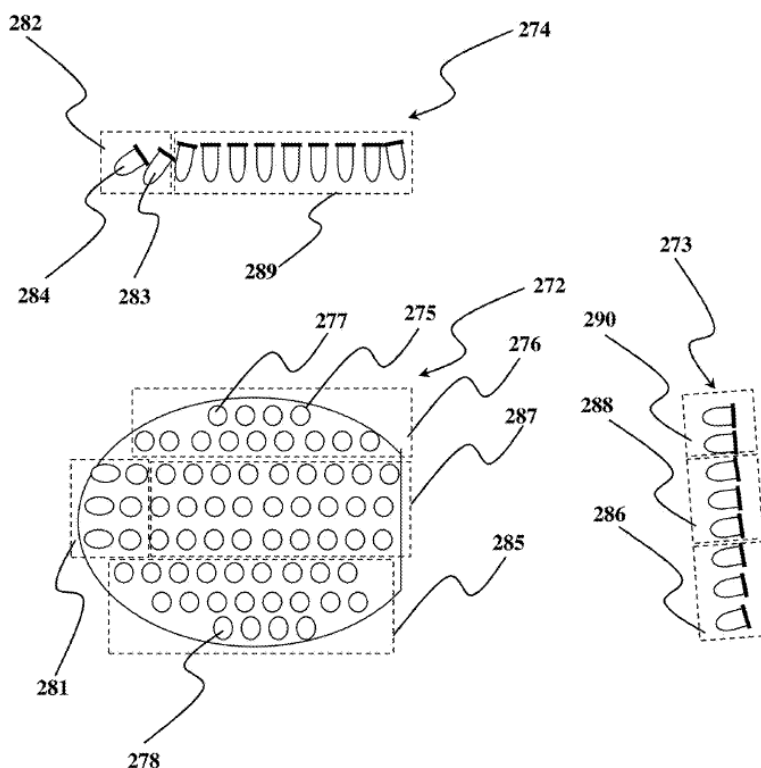
Petitioner identifies one civil action, *Torchlight Techs. LLC v. Daimler AG et al.*, No. 1:22-cv-00751 (D. Del.), as a related matter. *See* Pet. 176. Petitioner also identifies U.S. Patent Nos. 9,955,551 and 8,100,552 as having issued from parents of the application that issued as the ’503 patent, and U.S. Patent No. 11,208,029, as having issued from a child application. *See id.* at 176–177.

Patent Owner identifies two civil actions in which the ’503 patent has been asserted, *Torchlight Techs. LLC v. Daimler AG et al.*, No. 1:22-cv-00751 (D. Del.), and *Torchlight Techs. LLC v. General Motors LLC et al.*, No. 1:22-cv-00752 (D. Del.), both of which are pending. *See* Paper 4, 1. Patent Owner also identifies two

related *inter partes* reviews, IPR2023-00197 and IPR2023-00328. *See id.* at 1–2. Patent Owner additionally identifies seven other Patent Office proceedings concerning related patents. *See id.* at 2.

*B. The '503 Patent*

The '503 patent is titled “Detector Controlled Headlight System” and is directed to “[a]n automated headlight system for vehicles [that] replaces the high and low beam with a continuum of beam patterns, with further variable spatial distribution of intensities and color spectrum.” Ex. 1001, Abstract. The embodiment that corresponds to the challenged claims is depicted in Figure 15, reproduced in part below:



*Figure 15 shows a “multiple light-source headlamp.” Ex. 1001, 15:64.*

The figure above depicts “a headlamp 270 of a land, sea or air vehicle . . . in front view 272, side view of a section 273 and top view of a section 274.”

Ex. 1001, 53:17–19. A solid-state light source, “such as an LED 275 with [a] specific location within the cluster 276 has a specific spatial light distribution, color wavelength and aiming relative to the vehicle, such as straight ahead, and or downwards and or off towards the right or left.” Ex. 1001, 53:19–23. Different LED 277, which is “at a second location within the same cluster[,] may have a similar or dissimilar aiming, wavelength and spatial light distribution.” *Id.* at 53:29–31.

The patent explains that “headlamp control is automatic, from turning on automatically when ambient lighting levels fall to such a level where it is advantageous to have headlamps on, either to aid in illuminating the way ahead or facilitate being seen by others, to automatic dimming of high beam due to detection of oncoming vehicles and shut off when ambient lighting levels are sufficient.” Ex. 1001, 52:25–31. The patent further identifies “[a] possible control system for such purposes [that] is described in U.S. Pat. No. 6,281,632 by Stam, et al from Aug. 28, 2001,” in which “[i]f there is no oncoming traffic, then [the headlamp] operates as [a] high beam,” but “[i]f there is oncoming traffic, then it acts as [a] regular low beam.” *Id.* at 52:31–33, 52:55–57.

Claims 1 and 37 are independent and directed to vehicle headlight systems. They are reproduced in full below:

1. A vehicle headlight system comprising:
  - one or more headlamps and a vehicle structure, arranged for affixing components of the system to the vehicle;
  - a plurality of light clusters, arranged in each of the one or more of the one or more headlamps, the headlamps capable of projecting light so as to illuminate a plurality of sub-sections of a field-of-view with different illumination characteristics, the subsections determined in response to sensor data, wherein the light clusters operate to create a headlight beam;

electronic control circuitry configured to independently operate the light clusters;

one or more sensors configured to obtain and provide the sensor data predefined as pertinent to illumination requirements for the field-of-view; and

a logical controller including a processor, the processor in communication with a memory storing one or more algorithms, with the sensors, and with the control circuitry, wherein the processor is configured to process the one or more algorithms and the sensor data to determine an illumination for at least two of the sub-sections, that reduces illumination to reduce glare in at least a first of the at least two subsections and adapt the light emitted from one or more of the light-clusters so as to create the headlight beam that provides the determined illumination.

37. A vehicle headlight system comprising:

one or more headlamps affixable to a first vehicle;

a plurality of light clusters arranged in each of the one or more of the headlamps and capable of illuminating sub-sections of a field-of-view with different illumination characteristics, wherein at least two of the light clusters operate to create a headlight beam;

one or more sensors configured to obtain and provide sensor data, at least a portion of the sensor data indicating a second vehicle within the field-of-view; and

at least one processor configured to:

receive the sensor data;

process the sensor data to determine a light distribution pattern for an adaptive headlight beam, such that a headlight beam adapted to the pattern substantially illuminates a first subsection of the field-of-view including at least a portion of the second vehicle with an illuminance below a predefined threshold value, while the beam substantially illuminates at least the one or more second subsections of the field-of-view to either side of the first subsection with an illuminance above the predefined threshold value; and

instruct operation of at least two of the light clusters to create the adapted headlight beam.

## II. ANALYSIS

We discuss the appropriate level of skill in the art, claim construction, particularity of the Petition, the parties' arguments regarding the obviousness of the challenged claims, and Petitioner's motion to exclude.

### *A. Level of Ordinary Skill in The Art*

Petitioner contends that a person of ordinary skill in the art at the time of the alleged invention “would have had a bachelor’s degree (B.S.) in mechanical engineering, electrical engineering, optical engineering, applied physics, or an equivalent field, as well as at least 2 years of industry experience in the area of automotive lighting and lighting-control systems” and “may work as part of a team, for example, with computer engineers to integrate, program, etc., controllers and various control inputs to affect control of a given light cluster.” Pet. 6 (citing Ex. 1003 ¶¶ 42–44).

In the Preliminary Response, Patent Owner asserted that a person of ordinary skill in the art “would have had a Master of Science Degree (or a similar technical Master Degree, or higher degree) in an academic area emphasizing electrical engineering, computer engineering, or computer science with experience or education in optics and imaging systems or, alternatively, a Bachelor’s Degree (or higher degree) in an academic area emphasizing electrical, computer engineering or computer science and having two or more years of experience in the field of optical and imaging systems.” Prelim. Resp. 9 (citing Ex. 2001 ¶ 32).

At institution, we adopted Petitioner’s proposal, except that we omitted the qualifier “at least” and set the level of experience at two years. *See* Ins. Dec. 8. In its Response, Patent Owner states that it “does not dispute the Board’s proposed level of ordinary skill.” PO Resp. 20.

We accordingly maintain the level of ordinary skill in the art we adopted in the Institution Decision.

*B. Claim Construction*

We construe claims using the standard that would be applied in a civil action under 35 U.S.C. § 282(b), giving terms their ordinary and customary meaning to one of ordinary skill in the art in view of the specification and prosecution history. *See* 37 C.F.R. § 42.100(b).

The Petition discusses Patent Owner’s assertion, made during prosecution of a different patent, that “light source” should mean “individual LED” but asserts that “the applied references cover Patent Owner’s proposed construction.” *See* Pet. 7–8. Petitioner further stated that it “does not believe any other claim terms require specific construction and should receive their plain and ordinary meaning, in the context of the ’503 patent specification.” *Id.* at 8.

At institution, we interpreted the term “light source” as the Specification defines it: “any system that is capable of receiving an electrical signal and producing light in response to the signal.” Inst. Dec. 8 (citing Ex. 1001, 17:7–10 (“As used herein, the term ‘light source’, LED or ‘solid state light source’ means any system that is capable of receiving an electrical signal and producing light in response to the signal.”)). Patent Owner agrees with that construction. *See* PO Resp. 20.

However, the reason we interpreted “light source” in the institution decision was that there may have been a question about whether the individual “microbeams” described in the Beam reference were “light sources.” Because, as explained below, we do not reach the Beam grounds, we need not construe “light source” in this final decision. We further conclude that that no other express claim construction is necessary. *See Nidec Motor Corp. v. Zhongshan Broad Ocean*



*Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (explaining that construction is needed only for terms that are in dispute, and only as necessary to resolve the controversy).

C. *Particularity*

Patent Owner first argues that Petitioner’s arguments should be rejected because the Petition “fails to satisfy the particularity requirements of § 312.” PO Resp. 13; *see id.* at 20–33. We do not agree.

We addressed this issue at institution, explaining that “we understand the asserted combinations” and that “[a]ssertions that both references disclose a particular claim element do not undermine or overly cloud Petitioner’s asserted combinations.” Inst. Dec. 14. That remains the case. Patent Owner’s attempt to spin some loose language in the Petition into “47 grounds” (PO Resp. 13) is not persuasive, particularly *after* the institution decision, in which we explained how we viewed the combinations presented by Petitioner. *See* Inst. Dec. 10–13. The combinations are simply not as multiplicated and complicated as Patent Owner contends, and Patent Owner acknowledged at the hearing that the alleged multiplicity did not prevent it from addressing any issue. *See* Tr. 36:1–2 (“[Q]: Which of these did you address in your papers? [A]: We address every single one for every single claim.”).

Patent Owner also argues that “[the] lack of particularity is compounded by Petitioner’s other two petitions challenging the ’503 Patent that suffer the same lack of particularity issues—meaning Petitioner has asserted at least 149 grounds.” PO Resp. 32 (emphasis omitted). We again disagree with Patent Owner’s assessment of the number of “sub-grounds” at issue, and conclude, as we did at institution, that three petitions were justified given the number of asserted claims and differences in claim scope. *See* Inst. Dec. 14.

*D. Obviousness*

Petitioner asserts that claims 1–5, 7, 8, 10–14, 18, 19, 37–45, 47, 48, 50–53, 57, and 58 are unpatentable as obvious in view of Karlsson<sup>2</sup> and Harbers.<sup>3</sup> See Pet. 93–158. Petitioner adds Gotou<sup>4</sup> for dependent claims 9, 15–17, 49, and 54–56 and Braun<sup>5</sup> for dependent claims 6 and 46. See *id.* at 159–173.

*1. The Prior Art*

Karlsson describes a lighting device with a controllable lighting pattern. The overall structure is shown in Figure 3, which is annotated below:

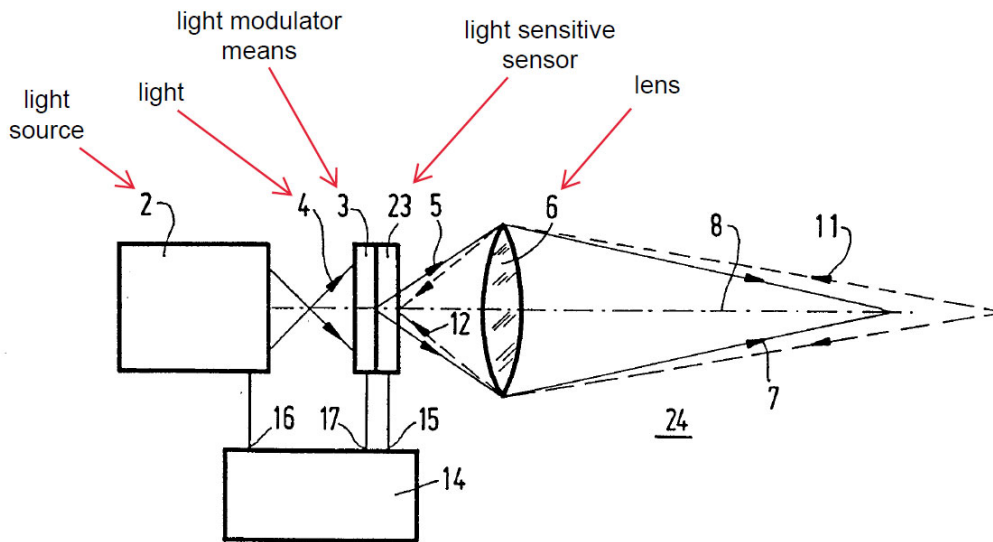


FIG. 3

*Karlsson's Figure 3 shows an embodiment with a light sensitive sensor. See Ex. 1010, 7:10–11.*

The above drawing shows a light source 2 that projects light 4 through a light modulator means 3, a light sensitive sensor 23, and a lens 6 to form a light

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<sup>2</sup> PCT Patent App. Pub. No. WO 98,54030 (Exhibit 1010).

<sup>3</sup> PCT Patent App. Pub. No. WO 01/01038 A1 (Exhibit 1011).

<sup>4</sup> U.S. Patent No. 5,588,733 (Exhibit 1012).

<sup>5</sup> PCT Patent App. Pub. No. WO 02/04247 A1 (Exhibit 1009).

beam 7. This arrangement “enables the combined use of a single optical system both for forming the light beam 7 to be emitted and for detecting ambient light, due to the intermittently control of the lighting means 2, 3, and of the light-sensitive sensor 23, if desired, such that one or the other can be controlled to be light transmittive or light blocking.” Ex. 1010, 11:19–23.

Karlsson further describes how “[t]he pattern of the light beam being emitted by the lighting device is automatically and dynamically adapted in dependence on the intensity and the direction of . . . light being detected” and that “[the] part of the light beam which might cause inconvenience to oncoming traffic is automatically suppressed, whilst retaining an optimum lighting effect for the driver of the vehicle himself.” Ex. 1010, 2:4–9; *see also id.* at 9:18–33 (“When the lighting device 1 is used as a headlight in a car, the pattern and the intensity of the light beam 7 are, for example, controlled in such a manner that no light at all or light having a low intensity is emitted in those directions from which light is detected by the light-sensitive sensor 9.”).

Harbers discloses a vehicle headlight system in which a “light beam generated by the light source has a continuously adjustable spatial distribution.” Ex. 1011, 1:26–27. The reference explains that its adjustable spatial distribution improves “the driver’s view of the road and the surroundings of the vehicle” because “objects situated on or in the axis of the light beam, such as oncoming traffic, can be better observed” and “also the observation of objects outside the center of the light beam is improved.” Ex. 1011, 2:33–3:2.

Gotou is also directed to a vehicle headlamp system. The pertinent disclosure describes adjusting the lighting direction based on map information provided by a navigation system. *See, e.g.*, Ex. 1012, 8:28–35; Fig. 3.

Braun is also directed a vehicle headlight system. Its pertinent disclosures describe identifying and “spotlight[ing] . . . roadway signs to improve readability” as well as how the system may identify and spotlight people. *See, e.g.*, Ex. 1009, 24:2–21, 26:29–27:4.

2. *Karlsson and Harbers*

a. *Independent Claims 1 and 37*

Independent claim 1 is generally directed to a vehicle headlight system with one or more headlamps with a plurality of light clusters. The headlamps are capable of projecting light to illuminate sub-sections of a field-of-view with different illumination characteristics, the subsections being determined in response to sensor data. Electronic control circuitry operates the light clusters and sensors obtain and provide data pertinent to the illumination requirements. A processor in a controller processes an algorithm and the sensor data to determine an illumination scheme to reduce illumination, and thus glare, in a first subsection.

We have reviewed Petitioner’s mapping of the claims to Karlsson (*see* Pet. 100–122) and conclude that Petitioner has shown that it discloses the subject matter of claim 1. As described above, Karlsson discloses a vehicle headlight system with a plurality of light clusters. The headlamps are capable of projecting light to illuminate sub-sections of a field-of-view with different illumination characteristics, the subsections being determined in response to sensor data indicating oncoming traffic. Control circuitry operates the light clusters and sensors obtain and provide data pertinent to the illumination requirements. A controller uses the sensor data to determine an illumination scheme that reduces illumination in a first subsection (i.e., one with the oncoming traffic) in order to reduce glare.

Independent claim 37 is similar to claim 1 but requires that the sensor data indicates a vehicle within the field-of-view and that a first subsection of the field-of-view (the one with the vehicle) is illuminated at a level below a “predefined illuminance” and a second subsection (with no vehicle) is illuminated at a level above the predefined illuminance.

We agree with Petitioner that Karlsson includes a “predefined” illuminance, namely its “dipped” illuminance, and that the first subsection would be illuminated below that predefined illuminance “because it receives ‘no light at all or light having a low intensity,’ which is below the dipped beam threshold.” Pet. 123 (citing Ex. 1003 ¶ 647; Ex. 1010, 9:18–26, Fig. 14).

With respect to the independent claims, the Petition included Harbers in the event Karlsson did not disclose “a plurality of light clusters.” See Pet. 94. Patent Owner does not argue that, however, and we conclude that Karlsson *does* disclose a plurality of light clusters in its “headlights.” Ex. 1010, 1:10. We note that, unlike some other claims of the ’503 patent, the claims at issue in this proceeding do not require multiple light sources arranged at different angles.

Because Harbers is not necessary to the combination for most of the claims, we need only address the motivation to combine with respect to claims 5 and 45, which we address separately below. See Section II.D.2.c.

*i. Illumination and Illuminating*

Patent Owner argues that “Karlsson does not teach determining illumination for either of the alleged shaded areas of no intensity” because there is no “illumination” when there is no intensity. See PO Resp. 65–66.

This is not persuasive because Karlsson teaches that “light beam 7 . . . [is] controlled in such a manner that no light at all *or light having a low intensity* is emitted in those directions from which light is detected [such that] glaring or

blinding of oncoming traffic is effectively prevented.” Ex. 1010, 9:18–26 (emphasis added); *see* Ex. 2006 ¶ 251. Light at a low intensity is “illumination,” even under the definition Patent Owner offers in the Response. *See* PO Resp. 64 (“The plain meaning of illuminate is ‘to supply or brighten with light’ or ‘to make luminous or shining.’”) That Petitioner may have described the shaded portions of Karlsson’s Figure 14 as having “no intensity,” is immaterial in view Karlsson’s “low intensity” disclosure, which Petitioner also cited. *See* Pet. 94–95.

*ii. Subsections Determined in  
Response to Sensor Data*

Patent Owner argues that “Petitioner improperly merges Karlsson’s description of a prior art sensor at 2:2-4 with Karlsson’s disclosure of its control means 14 at 9:9-17” when addressing the “subsections determined in response to sensor data” claim language. PO Resp. 66–67. Patent Owner also argues that “Karlsson discloses light-sensitive sensors 9/23 that determine light direction,” but “does not disclose that its light-sensitive sensors determine light distribution or sub-sections.” *Id.* at 67–68.

These arguments are unpersuasive. Karlsson clearly explains that “[w]hen the lighting device 1 is used as a headlight in a car, the pattern and the intensity of the light beam 7 are, for example, controlled in such a manner that no light at all or light having a low intensity is emitted in those directions from which light is detected by the light-sensitive sensor 9.” Ex. 1010, 9:18–22. The sensors do not determine the light distribution (because they are just sensors), but the control means does perform that function. *See id.* at 8:19–9:17 (“The light modulator means 3 are controlled by the control means 14 in such a manner that the light 4 emitted by the light source 2 is processed into a light beam 7 having a desired pattern and intensity.”).

With respect to claim 37, Patent Owner also argues that “Petitioner’s proffered proof, annotated Fig. 14,” does not show that “the beam substantially illuminates at least the one or more second subsections of the field-of-view to either side of the first subsection with an illuminance above the predefined threshold value.” PO Resp. 68. We disagree. Petitioner’s annotated Figure 14 shows left and right shaded subsections to either side of high intensity central section. The high intensity section is above the “dipped” illumination and to a side of each shaded sections. Patent Owner argues that Karlsson’s “beam 50 does not encompass plural sections or sections to either side of the first subsections as claimed” (*id.*), but claim 37 does not require “plural sections or sections to either side”—it simply recites substantially illuminating “*one or more* second subsections . . . to either side of the first subsection.”

*iii. Conclusion as to the Independent Claims*

Patent Owner does not otherwise contest Petitioner’s unpatentability assertions regarding independent claims 1 and 37, and any arguments not presented have been waived.

We have considered Petitioner’s contentions in light of the full record and conclude that, for the reasons provided in the Petition, and as discussed above, Petitioner has shown that claims 1 and 37 would have been obvious in view of Karlsson.

*b. Dependent Claims 2–4, 7, 8, 9, 10–14, 18, 19, 38–44, 47, 48, 50–53, 57, and 58*

Patent Owner does not make separate arguments for claims 9, 10, 12, 13, 18, 19, 38–41, 43–44, 51–53, and 57, but does offer separate arguments for the rest of the dependent claims included in this ground, as discussed below.

*i. Light Modifying Elements*

Claims 2 and 42 recite “one or more light modifying elements provided in the path of light emitted from at least one of the sources, further controlling the light-source characteristics,” and claim 58 recites “at least one of reflectors, refractors, or lenses usable to alter emitted light from at least one of the light clusters as part of the instructed operation.”

Patent Owner argues that “Karlsson discloses a passive (not controllable) lens 6,” and therefore does not “teach controllable ‘light modifying elements’ or ‘lenses usable to alter emitted light from at least one of the light clusters as part of the instructed operation.’” PO Resp. 69.

Patent Owner’s argument is based on an implicit construction of these claims that would require *active* control of a reflector, refractors, or lens that we find insufficiently supported. Nothing in claims 2 or 42 requires active control, and the “instructed operation” of claim 37 is of the light clusters (i.e., the LEDs) *not* a reflector/refractor/lens. Moreover, claim 58 only requires that the reflector/refractor/lens be “usable to alter emitted light . . . as part of the instructed adjustment.” In both the ’503 patent and the prior art, the light that is being adjusted, for example by LEDs being dimmed according to an instruction, would also be passively “controlled” by a lens through which it passed.<sup>6</sup>

*ii. Vehicles or Entities*

Claims 7, 8, 11, 47, 48, and 50 all require either “determin[ing] a position of the oncoming [or preceding] vehicle” or “identifying entities.”

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<sup>6</sup> Patent Owner does not point us to a description in the ’503 patent of active control of a reflector, refractor, or lens, and our review of the patent suggests that, at least for the headlight embodiment, there is no such disclosure. *See* Ex. 1001, 52:4–57:42.



Patent Owner argues that “Karlsson does not disclose determining a position of a vehicle associated with the detected light, identifying the vehicle, or detecting the vehicle.” PO Resp. 70. Instead, argues Patent Owner, “[w]ith reference to the Figure 14 embodiment, the proffered evidence of record, Karlsson does not disclose a controller or storage means connected between the sensors (S) and the sources to determine a vehicle position” because “each sensor is functioning as a switch for the adjacent LED(s).” *Id.* Patent Owner further argues that “Petitioner’s proof for identification of oncoming traffic is also flawed,” because it relies on Karlsson’s detection of light and “it is not an inherent truth that this equates to determining or identifying a vehicle.” PO Resp. 70–71.

These arguments are unpersuasive because, in addition to the Figure 14 embodiment, Karlsson discloses “light-sensitive sensors 9 and 23” that “are preferably designed to be capable of precisely determining the direction and the intensity of the detected light 11,” and “may for example be comprised of a matrix of photo diodes or in the case of a light-sensitive sensor 23, a photo-sensitive plate as used in modern video cameras.” Ex. 1010, 12:19–24.

In Karlsson, as in the ’503 patent and other prior art that is of record in this case, the light detected by the vehicle, which is, generally speaking, operating on a road, is presumed to be headlights, which are used as a proxy for an oncoming vehicle. *See* Ex. 1010, 5:16–18 (explaining how the “sensor means” are “used for detecting ambient light and light from oncoming traffic as a parameter to which the pattern of the emitted light beam is to be adjusted”), 9:18–22 (“the pattern and the intensity of the light beam 7 are, for example, controlled in such a manner that no light at all or light having a low intensity is emitted in those directions from which light is detected by the light-sensitive sensor 9 . . . [i]n this manner glaring or blinding of oncoming traffic is effectively prevented”), 15:17–22 (“Detected

incident light . . . is transmitted to the light-sensitive sensor 43, for the purpose of precisely detecting the intensity and the direction of detected light, such as light from oncoming traffic or ambient light in the case of a lighting device 40 in the form of a headlight of a motor vehicle.”); Ex. 1001, 52:66–67 (explaining that “analysis by a detector or an imaging system of the oncoming vehicle’s position” may be done “using its headlights for example”); Ex. 1007, 32 (“The image sensor should be just sensitive enough to image oncoming headlamps at the maximum distance for which the controlled vehicle's headlamps should be dimmed.”).

We conclude that Karlsson determines the position of vehicles, or identifies them, in the same way as at least some embodiments of the ’503 patent.

*iii. Camera*

Claims 14 and 53 recite that the “the one or more sensors further includes at least one of a camera, a microphone, an ultrasonic transducer and receiver, or an electromagnetic radiation source and detector including any of IR, UV, laser, or light.” The Petition asserts that Karlsson’s “sensor 9, 23” is a “video camera.” Pet. 147 (citing Ex. 1010, 12:19–24).

Patent Owner argues that Karlsson’s “matrix of photo diodes alone is not a camera,” that “[a] camera also requires a lens to focus the received light, and to be able to deliver the sensed array for processing and imaging,” and that one of ordinary skill in the art “would have known that a modern video camera in the early 2000s would have required many thousands of photosensors.” PO Resp. 74. Patent Owner also argues that “a camera would not have included photosensors interspersed with emitters because this would have resulted in low resolution data that could not be formatted into an image,” and “[f]urther, [that] the lack of sensors in the lower region of the array results in no data in this region and Karlsson does

not disclose image processing, at all, so it is clear that the spotlight sensors are limited to sensing light.” *Id.*

We agree with Petitioner that Karlsson’s disclosure that “the light-sensitive sensors 9 and 23 . . . may for example be comprised of a matrix of photo diodes or in the case of a light-sensitive sensor 23, a photo-sensitive plate *as used in modern video cameras*” (Ex. 1010, 12:19–24, emphasis added) is sufficient to teach or suggest the claimed “camera.” Patent Owner does not offer a construction of “camera” that would exclude Karlsson’s light-sensitive sensor 23, which obtains data that amounts to images of the field-of-view. We need not decide whether the interspersed photosensors of the Figure 14 embodiment might be a “camera” because we conclude that sensor 23 is sufficient.

*c. Dependent Claims 5 and 45*

Patent Owner does not separately argue claims 5 and 45. However, these claims require “illuminat[ing] at least one of the at least two sub-sections of the field-of-view with a different color of light from another of the at least two sub-sections” and Petitioner relies on Harbers for the different colors. *See* Pet. 136–138. We thus must address the motivation to combine Karlsson and Harbers for these claims.

Petitioner asserts that it would have been obvious to combine Harbers with Karlsson in order “to provide different spatial distributions for improved visibility in different situations (off-axis viewing, bends, narrow roads, motorways, etc.[]) thereby improving safety.” Pet. 96 (citing Ex. 1011, 1:10–13, 1:16–27, 4:17–21, 5:14–26, 6:1–7, 6:27–7:32, 9:28–10:5, 13:5–7, Figs. 1B, 2; Ex. 1003 ¶¶ 549–550).<sup>7</sup>

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<sup>7</sup> It may have been more natural to use Harbers as the “base reference” and modify its teachings with Karlsson’s teachings regarding selective dimming, but we consider the combination as presented in the Petition.

Patent Owner argues that the Petition does not explain “what elements are missing from the primary reference, what elements should be added from the secondary reference to reach the claimed invention, or why those particular elements would be obvious to add” and that the grounds are “inconsistent as to how the primary and secondary references should be combined and the rationale for doing so.” Pet. 76. We disagree. The Petition explains that the combination would use Karlsson’s hardware but employ Harbers’ lighting scheme that tailors the spatial distribution and, in some embodiments, colors, to a particular scene. *See* Pet. 96–98.

Patent Owner argues that one of skill in the art “would not interchange the teachings of the LED array and light modulator embodiments to provide redundant modulation and reduced optical efficiency.” PO Resp. 78. This is not persuasive because the combination would not include redundant elements, it would simply apply Harbers’ teachings regarding the different spatial and spectral distributions.

Patent Owner also argues that the combination would be “an inefficient and cost-prohibitive combination [that] would be unsuitable, especially in the extremely cost-conscious automotive industry.” PO Resp. 78 (citing Ex. 2006 ¶ 297). This argument is unpersuasive because neither Patent Owner nor Petitioner explain why or how the combination, which essentially just modifies Karlsson’s system with different color light sources and a different control scheme, would be an “inefficient and cost-prohibitive combination” or “unsuitable.”

Patent Owner next argues that “Karlsson already provides ‘different spatial distributions for different driving situations’ such that there would be no increased/improved driver safety or visibility, and therefore no motivation for a POSA to look to Harbers to provide these features as advanced by Petitioner.” PO Resp. 79. We agree that Karlsson already tailors its illumination scheme to some

extent, but that would not preclude one of ordinary skill from looking to Harbers for a different and potentially better scheme, because the law “does not require that a particular combination must be the preferred, or the most desirable, combination described in the prior art in order to provide motivation for the current invention.” See *In re Fulton*, 391 F.3d 1195, 1200 (Fed. Cir. 2004).

Patent Owner also argues that “[s]ince Harbers’ curved substrate is optional, a POSA would have understood that it is not needed to provide Harbers’ different spatial distributions – therefore a POSA would not have been motivated to combine Karlsson with Harbers’ unnecessary hardware.” PO Resp. 80. This argument is unpersuasive because it is premised on the idea that the curved substrate would be part of the combination, but the claims do not require that. The Petition relies on Harbers’ “multiple directional beam segments” (Pet. 96), which exist in all embodiments of Harbers, not the curved substrate.<sup>8</sup>

Patent Owner further argues that the combination would have conflicting control strategies and that, for example “Harbers software would attempt to widen the beam and decrease central forward illumination . . . at the same time as Karlsson would attempt to maintain dimming of the sides that Harbers is attempting to illuminate, as well as maintain intense forward illumination that Harbers is attempting to dim.” PO Resp. 81. These arguments are unpersuasive because one of ordinary skill in the art would have known to take the aspects of the different strategies that would be desirable for a given application or situation. A proper obviousness analysis considers whether the claimed subject matter would have been obvious in light of the teachings of the prior art, not whether the

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<sup>8</sup> Patent Owner acknowledges that one of ordinary skill in the art would have “understood that [the curved substrate] is not needed to provide Harbers’ different spatial distributions.” PO Resp. 80.

particular embodiments disclosed in the prior art could actually be combined. *See Allied Erecting and Dismantling Co., Inc. v. Genesis Attachments, LLC*, 825 F.3d 1373, 1381 (Fed. Cir. 2016) (“The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference.”) (quoting *In re Keller*, 642 F.2d 413, 425 (CCPA 1981)).

Finally, Patent Owner argues that “Petitioner also does not explain how any segmentation would occur in the absence of Harbers’ software.” PO Resp. 81. We find this argument unpersuasive because we do not agree that the combination would lack Harbers’ software; to the contrary, one of skill in the art would readily understand that some type of programming would be needed to control the light sources to achieve the benefits Harbers describes.

We find Patent Owner’s arguments against the combination unpersuasive, and conclude that the Petition sufficiently established a motivation to combine Karlsson and Harbers.

### 3. *Karlsson, Harbers, and Gotou: GPS*

Claims 9 and 49 require that “the one or more sensors includes a GPS sensor,” and claims 15–17 and 54–56 require determining a road curve or upcoming turn “indicated by the sensor data.”

The Petition contends that one of ordinary skill “would have been . . . motivated to modify Karlsson-Harbers to adjust light based on GPS sensor data including road curvature, as in Gotou, to further control Karlsson-Harbers’ light to illuminate curves/turns.” Pet. 159 (citing Ex. 1010, 1:16–26, 4:17–21, 9:18–26; Ex. 1003 ¶¶ 103–113, 772–775).

Patent Owner argues that “Karlsson discloses providing full or maximum intensity light in the remaining areas outside of the anti-glare region corresponding to detected incoming light to the greatest extent possible, i.e., everywhere it could

be needed” and that “[u]nder such circumstances, there would be no reason to increase light in the direction of the curve, nor would there be remaining unlit LEDs with which to achieve the increase.” PO Resp. 85.

This argument is unpersuasive because, as explained above, we do not agree that Karlsson requires full usage of its array except when accommodating glare. Karlsson explains that “the emitted light beam 50 is represented as a window which can shift in the plane of the drawings from the left to the right and from the top to the bottom, if desired, and vice versa,” and that the window “may vary as regards its shape and dimension in dependence on the desired pattern and direction of the beam.” Ex. 1010, 19:29–33. So, for example, Karlsson could operate with high intensity window in the center when driving on a straight road, if desired, and additionally illuminate a side in the case of a curve or turn.

Patent Owner does not otherwise contest Petitioner’s unpatentability assertions regarding claims 9, 15–17, 49, and 54–56, and any arguments not presented have been waived. We have considered Petitioner’s contentions in light of the full record and conclude that, for the reasons provided in the Petition, and as discussed above, Petitioner has shown that these claims would have been obvious in view of Karlsson, Harbers, and Gotou.

4. *Karlsson, Harbers, and Braun: IR/UV*

Claims 6 and 46 and require that the light output includes light in infrared or ultraviolet wavelengths.

The Petition asserts that one of ordinary skill in the art “would have been further motivated to modify Karlsson-Harbers to include IR/UV wavelengths, as in Braun, to further control Karlsson-Harbers’ adaptive headlamps to illuminate a roadway, thereby improving visibility.” Pet. 167 (citing Ex. 1009, 3:4–27, 8:4–5, 9:23–28, 14:21–30, 18:13–14, 19:9–21, 20:25–21:16, Figs. 3–6; Ex. 1003,

¶¶ 101–112, 114, 849–850; Ex. 1010, 1:16–26, 4:17–21, 9:18–26; Ex. 1011, 5:1–26, 7:1–14, 9:1–32). According to Petitioner, Braun’s luxels “would have provided improved illumination of fluorescent surfaces (UV luminescence) and/or provided distance ranging to objects (IR sensing).” *Id.* at 168 (citing Ex. 1003 ¶¶ 852–853).

Patent Owner argues that “[t]he Petitioner relies on Braun’s luxels for satisfying this limitation” but that “does not provide any explanation for how and why a POSA would have combined or substituted Karlsson’s lamp-SLM or Harbers’s LEDs with Braun’s luxels” or “explain how either Karlsson or Harbers’ software would have any idea how or when to control such luxels, or what LEDs would be replaced, or what effect this would have on the overall system.” PO Resp. 86–87.

We do not agree that Petitioner has not articulated why one would use Braun’s luxels. The Petition and Dr. Jiao explain that the luxels “would have provided increased illumination of certain surfaces (e.g., fluorescent surfaces), for example, road signs, road markers” and that “IR sensing would have provided longer distance detection of objects (e.g., vehicles, road signs, road curvature, etc.).” Ex. 1003 ¶¶ 852–853.

We find that it would have been within the level ordinary skill to incorporate luxels into Karlsson’s headlight system. This combination requires little more than using luxels (already being used as the light source for vehicle headlights in Braun) in Karlsson’s headlight light sources, and employing Karlsson’s selective dimming. Patent Owner’s arguments about “tradeoffs involving complex and interrelated optics, heat management, white LED lumen output, packaging and cost issues” (PO Resp. 87) are unpersuasively vague and conclusory, particularly given



the relatively straightforward nature of the changes to Karlsson's system that would be required.

Patent Owner does not otherwise contest Petitioner's unpatentability assertions regarding claims 6 and 46, and any arguments not presented have been waived. We have considered Petitioner's contentions in light of the full record and conclude that, for the reasons provided in the Petition, and as discussed above, Petitioner has shown that these claims would have been obvious in view of Karlsson, Harbers, and Braun.

*E. Grounds Based on Beam and Thominet*

Because we have already determined that claims 1–19 and 37–58 are unpatentable in view of the grounds based on Karlsson and Harbers, we need not address Petitioner's challenges to those claims based on Beam and Thominet.

*F. Petitioner's Motion to Exclude*

Petitioner seeks to exclude the testimony of Patent Owner's declarant, Dr. Turk, asserting that he does not meet the agreed level of ordinary skill in the art. *See* Paper 34 ("Mot. to Exclude") 1. Specifically, Petitioner argues that the agreed level of skill requires "at least 2 years of industry experience in the area of automotive lighting and lighting-control systems" and that Dr. Turk lacks such qualifications. *See* Mot. to Exclude 4–6; Paper 38 ("Mot. to Exclude Reply") 3–4 (arguing that Dr. Turk "has no experience with a vehicle headlamp company, an LED (or any other light source) company, or lighting design, or awards/patents for a vehicle forward lighting system" (citing Paper 31, 4–5)).

Because Petitioner has prevailed on all of the claims, and our decision does not rely in any way on Dr. Turk's testimony, we conclude that the Motion to Exclude is moot. It is therefore dismissed.

### III. CONCLUSION

Petitioner has met its burden of showing that claims 1–19 and 37–58 of U.S. Patent 10,894,503 B2 are unpatentable.<sup>9</sup>

Claim(s)	35 U.S.C. §	Reference(s)	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1–5, 7–8, 10–14, 18–19, 37–45, 47–48, 50–53, 57–58	103(a)	Karlsson, Harbers	1–5, 7–8, 10–14, 18–19, 37–45, 47–48, 50–53, 57–58	
9, 15–17, 49, 54–56	103(a)	Karlsson, Harbers, Gotou	9, 15–17, 49, 54–56	
6, 46	103(a)	Karlsson, Harbers, Braun	6, 46	
1–5, 7–8, 10–14, 18–19	103(a)	Beam, Thominet <sup>††</sup>		
37–45, 47–48, 50–53, 57–58	103(a)	Beam, Thominet, Stam <sup>††</sup>		

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<sup>9</sup> Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

<sup>††</sup> As noted above, we do not reach this ground because we determine those claims are unpatentable in view of the Karlsson and Harbers grounds. See Section II.E.

9, 15–17	103(a)	Beam, Thominet, Kobayashi <sup>††</sup>		
49, 54–56	103(a)	Beam, Thominet, Stam, Kobayashi <sup>††</sup>		
6	103(a)	Beam, Thominet, Braun <sup>††</sup>		
46	103(a)	Beam, Thominet, Stam, Braun <sup>††</sup>		
Overall Outcome			1–19, 37–58	

#### IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner has shown by a preponderance of the evidence that claims 1–19 and 37–58 of U.S. Patent 10,894,503 B2 are unpatentable;

FURTHER ORDERED that Petitioner’s Motion to Exclude Evidence is dismissed as moot; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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